LAVA CREEK BRIDGE
Yellowstone Roads and Bridges
Spanning Lava Creek on Grand Loop Road
Yellowstone National Park
Park County
Wyoming

HAER No. WY-34

BLACK & WHITE PHOTOGRAPHS

WRITTEN HISTORICAL & DESCRIPTIVE DATA

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

LAVA CREEK BRIDGE
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Location:	Spanning Lava Creek on Grand Loop Road, 4.1 miles east of Mammoth Hot Springs, Yellowstone National Park, Park County, Wyoming UTM: Mammoth, WY, Quad. 12/529080/4976230
Date of Construction:	1933
Owner:	Yellowstone National Park, National Park Service
Use:	Vehicular bridge
Designer:	Architectural plans by Branch of Plans and Design, National Park Service General plans and specifications by H.R. Anguin, Bureau of Public Roads
Builder:	S.J. Groves and Sons
Significance:	Lava Creek Bridge typifies the early design philosophy of the National Park Service, which was to use indigenous materials to harmonize man-made features with their natural surroundings. This philosophy is embodied in many of the park's Rustic Style buildings and structures.
Project Information:	Documentation of Lava Creek Bridge is part of the Yellowstone Roads and Bridges Recording Project, conducted during the summer of 1989 by the Historic American Engineering Record, a division of the National Park Service, under the co-sponsorship of Yellowstone National Park, the NPS Roads and Bridges Program, and the NPS Rocky Mountain Regional Office, Denver. Historical research and written narrative by Mary Shivers Culpin, Historian, NPS Rocky Mountain Regional Office. Engineering description by Steven M. Varner, Virginia Polytechnic Institute. Edited and transmitted by Lola Bennett, HAER Historian, 1993.

HISTORY OF GRAND LOOP ROAD

(See HAER WY-24, Yellowstone Roads and Bridges.)

HISTORY OF MAMMOTH HOT SPRINGS TO TOWER JUNCTION ROAD

Prior to the creation of Yellowstone National Park, miners began exploring and settling in the Upper Yellowstone Valley, an area extending from present-day Livingston, Montana, to the northern boundary of Yellowstone National Park at Gardiner, Montana. Miners who had worked the Idaho gold fields moved on to Montana after news of John White's gold strike on Grasshopper Creek (Bannock) in 1862. The following year Thomas Curry's discovery of gold near Emigrant Gulch in the Upper Yellowstone Valley brought a rush of miners to the area. The strikes also brought miners to the southern part of the Upper Yellowstone Valley. The town of Jardine, Montana, just north of the northern boundary of the Park, grew out of the success of the Bear Creek discoveries.[1]

In the late 1860s, more mining activity developed along Crevice Creek and eastward toward Lake Abundance and down into Clarks Fork Valley. In 1870 silver and lead deposits were discovered in the Cooke City, Montana, area, soon to be named the New World Mining District.[2] As mining activity increased in the New World Mining District, an enterprising Scot, John H. "Yellowstone Jack" Baronett gave up prospecting and pursued "mining the miners' by controlling the only known good bridge site on the route from the Upper Yellowstone Valley to the New World Mining District. By 1871 a rough trail or road from the Upper Yellowstone Valley to the Cooke City mines and Baronett's newly built bridge over Yellowstone River, allowed the miners to traverse the park a year before Yellowstone National Park was established.

In Superintendent Philetus Norris' first report to the Secretary of the Interior in 1877, he deemed the construction of a wagon road from Mammoth Hot Springs to Henry's Lake via the Tower Falls, Mount Washburn, Cascades, Yellowstone Falls, the Lake, Firehole Basin, and the Nez Perce route through to the west side a "pressing necessity". Norris felt that this route could connect almost all of the major points of interest and the existing approach road into the park.[3] The following year, Norris' top priority was the construction of a road from Mammoth Hot Springs to Lower Geyser Basin; however, a small crew began work on a new road on Gardner River toward Yellowstone Falls and Lake Yellowstone.[4] In 1879 the road crews improved the route from Mammoth Hot Springs to Lake Yellowstone via Mud Volcano, Sulphur Mountain, the Falls, Mount Washburn, Tower Falls, the Forks of the Yellowstone, and the east canyon of the Gardner River.[5] Evidently not satisfied with the route from Mammoth Hot Springs via the Falls, to Lake Yellowstone, Norris spent the last few days of the 1880 season exploring for a new and shorter route from the Cascades of East Gardner River, through a pass in the Stephens Range east of Thompson's Peak, and through another pass of Washburn Range at the head of a fork of Cascade Creek, west of Dunraven Pass. Bridges were constructed on several streams including branches of Gardner River.[6] In 1881 Norris' assistant, C.M. Stephens, supervised the construction of a bridge over the East Fork of Gardner River, at the head of the middle falls, one bridge at the head of the upper falls of the East Fork of Gardner River, one bridge over the main Blacktail Deer Creek, one bridge over Elk Creek near Dry Canyon.[7]

In 1887 the Army Corps of Engineers, which assumed responsibility for road construction in 1883, described this section of the road to Cooke City, over which all supplies for the mining camp are freighted, as:

> rough and hilly country and throughout the greater portion of its extent is unimproved. Some slight grades have been made where it

> was absolutely necessary and a few crude bridges constructed. The road has been chiefly built and kept in repair by private enterprise and is by far the worst road in the park, being will nigh impassable a large portion of the year. ... In my last annual report I recommended the construction of a good road from ... the Falls the road to be continued down the Yellowstone to a junction with the present road to Cooke City, the latter road to be improved from the point of junction to Mammoth Hot Springs.[8]

In 1896 a survey was completed for a new improved route eastward from Mammoth Hot Springs.[9] The following year, the Army planned to build new road section from Undine Falls on the East Gardner, on the south side of the canyon to Mammoth Hot Springs. The older mail route to Cooke City followed along the north side of the canyon which is "both difficult and dangerous for vehicles." The Army found that this section required "about one mile of the heaviest, most difficult and most expensive work, ... requiring in one place a stone retaining wall and substantial danger guard ... the remainder with the exception of the approaches to the proposed bridge across the Middle Gardner embraces no difficulties of importance."[10]

Another survey was made on a section of the Mammoth Hot Springs to Tower Falls road during April and May 1902. The crew covered a six-mile segment from Crescent Hill to a crossing of the Yellowstone and beyond. Captain Chittenden of the Army Corps of Engineers described the work in his report of 1902:

> The old road down into the valley while comparatively direct takes a drop of 1300 feet in about 3 miles Lava Creek Bridge and with grades corresponding and it was to eliminate these gradients that the new road was located and constructed. From Crescent Hill the location for the new road was carried well up on the side of the mountain to avoid drifting snow in the winter time. A 6 percent grade was used for 1,600 feet in gaining the summit. In getting down to the river from the summit at Crescent Hill and the Yellowstone River at the crossing was found to be 1,571 feet, while the distance was 5 miles. Immediately upon crossing the river a 10 percent grade for about 1300 feet was established in order to reach the high land above the river quickly and to avoid heavy rock work. The construction party consisting of 40 men and 10 teams with camp equipment left the Springs on the 10th of March and Crescent Hill was reached and camp established on the 13th. The instructions to the road crew were to construct a correct but narrow road down the mountain surveyed, the idea being that the road once established on proper lines could be brought up to the standard of the park roads at a later season. Considerable rock was encountered during the construction and to avoid work of this character as much as possible considerable cribbing was put in, 260 linear feet all told. The amount of solid rock handled was 2,176 yards costing $1395. The amount of loose rock handled was 3,643 cubic yards costing $1,092.90. The amount of earth handled was 17,709 cubic yards at a cost of $3,187.62. The right of way cleared of timber to an average width of 33 feet. All stumps were grubbed and the refuse

> either burned or hauled to one side. There was 14,800 linear feet of bridging built, including 80 linear feet of culverts, part of the lumber used was sawed on the ground. The balance was hewed logs and poles. The bridges are 16 feet wide. The cost of the 431 linear feet of bridging was $599.86 at the rate of $1.39 per linear foot. The cost amount given above do not include the subsistence of the men nor the prorated office expenses of the party.[11]

By 1903, grading had almost been completed on the road from Mammoth Hot Springs and three piers of the new high bridge for the Gardner River crossing had been placed. The steel for this bridge and eight others had been delivered from the American Bridge Company.[12] The next year a half-mile section of the old road was rebuilt and rerouted to eliminate a dangerous segment near Ox Bow Creek, and Crescent Hill Canyon road was "widened to full width".[13]

The new five-span steel-arch bridge over Middle Gardner River, also described as the "new high bridge" was the largest bridge in the park. Each span was 76' long and the two approaches were each 15' long, making a total length of 410'. The floor was 70' above the river. Construction of the bridge at this location eliminated nearly 2,000 feet of road and a 60-foot rise and fall at this crossing of the river as compared with the old road.[14] During 1905, Captain Chittenden studied the possibility of rerouting at least 1,000 feet of the road near the head of the falls of East Gardner River and at its crossing. Chittenden questioned the siting of the dangerous section which had been built eight years before. He felt that it probably should have been built located on the lower location. Several very large slides during the winter of 1905-06 destroyed large sections of retaining walls and the resulting condition of the road just reiterated Chittenden's position. The transportation companies also expressed their concern over the safety of the road. The concessionaires felt that even if the retaining walls were rebuilt, the width of the road made it too dangerous for four-line teams to pass safely. Chittenden knew that in order to make the road safe, it would have to be widened. This would be a costly procedure as a considerable distance of widening would be through solid rock with a depth of 20 feet or more. Thus, Chittenden recommended a new lower route which would be more satisfactory. His successor, Lt. Peek, agreed with this recommendation; however, lack of funds prevented any action for 1906.[15] Numerous bad slides occurred on the road about 3½ miles east of Mammoth Hot Springs during 1907. The bad conditions in this section of the road reinforced Lt. Peek and Major Chittenden's decision to reroute the road to better ground and also to avoid a long grade.[16]

A period of inactivity followed for the few years. Chittenden and Peek's recommendation was tabled, but the "high" bridge was repainted in 1913 as part of a parkwide bridge improvement program.[17] The next major road program affecting this section came after the Bureau of Public Roads assumed road construction responsibility in 1926.[18]

Among the first reconnaissance surveys planned by the National Park Service for the Bureau of Public Roads, was the Mammoth Hot Springs to Tower Junction segment.[19] Location surveys for the road were made in 1930 and in 1932. In 1933 Emergency Conservation Work funds employed local men to work on the Mammoth Hot Springs to Tower Junction project. The men worked well into the winter on this segment nearly completing the grading between Tower Junction and Lava Creek.[20] The grading and surfacing were handled under several contracts with the bituminous surfacing completed in 1936. Attention and study had been given to the "high bridge site" as early as 1929. Landscape Architect Gilmore Clark, of the New York Westchester County Park Development, included his assessment of the bridge site in his "Mammoth Plan". Clark agreed with the proponents of a "high bridge" plan as it was suitable from a landscape viewpoint. The Bureau of Public Roads ran differing alternate lines and figured several cost estimates for the bridge location. Finally in 1935, all interested parties mutually

agreed that the "high bridge" should be constructed.[21] During the construction of the "high" bridge, Gardner River Bridge, the road crews obliterated many of the old road scars from the various routes, some dating to the 1880s.[22]

The Mammoth Hot Springs to Tower Junction section of Grand Loop Road can be described in two segments, from Tower Junction to the entrance of Route 508, the Blacktail Deer Plateau Drive, and from Blacktail Deer Plateau Drive west to the terminus of Grand Loop and a junction with Route 11 (North Entrance Road) at Mammoth Hot Springs.

The 8.62-mile Tower Junction to Blacktail Deer Plateau Drive segment ranges from 22' to 24' in width shoulder-to-shoulder with a pavement or bituminous plant mix surface width of 22' to 24'. The condition is fair to good. Some of this segment received a maintenance overlay in 1984-85. The base condition is fair and the drainage condition is good. The shoulder width is from 0' to 2' and the shoulder condition is good. The horizontal alignment is fair and the vertical alignment is good. The roadsides are open and revegetated with minor encroachment of vegetation in some areas. There are no major structures on this segment.

The 9.58-mile Blacktail Deer Plateau Drive to Mammoth Hot Springs has a roadway width of 22'. The condition of the bituminous plant mix surface is poor. There are no shoulders. The roadside conditions are generally good with minor encroaching in some areas. The base condition is fair and the drainage condition is good. The horizontal alignment is fair and the vertical alignment is good. There are three major structures on this segment, a reinforced concrete box culvert with masonry headwalls, Lava Creek Bridge, and Gardner River Bridge.

In 1985 the average daily traffic over the Tower Junction to Mammoth Hot Springs section of Grand Loop Road was 2,600 vehicles with an anticipated average daily traffic of 3,200 by 2005.[23]

DESIGN AND CONSTRUCTION OF LAVA CREEK BRIDGE

Beginning in 1926, plans were being made for the construction of a bridge over Lava Creek. Horace Albright, Superintendent of Yellowstone National Park, sent a proposed plan of the bridge to Daniel Hull, Chief of the Landscape Engineering Division of the National Park Service for his approval. In turn, Hull submitted two plans to Engineer Burt Burrel, which he believed disguised the "usual appearance of an I-beam girder bridge." Hull wanted these designs to be considered "more or less standard designs for other spans, not to exceed 15' in clear opening in as much as quite a supply of 16-foot I-beams is now on hand in Yellowstone National Park."[24] Hull recommended a bridge design which was based upon a sketch for Slate Gulch Bridge on Merced River in Yosemite National Park. The other proposed plan must have used the use of more of the surplus steel, because Hull related to Burrel, "You will notice that in both cases the outside appearance is obtained by shell construction only, and has no real relation to the strength of the structure itself but they are merely for appearance sake".[25]

The survey for a bridge site over Lava Creek in 1930 found two possible locations. One was on a route that "ran on the south side of Lava Creek down the Undine Grade" and it crossed Lava Creek "just below the present Lava Creek Bridge, through the camp ground and along the cliff about fifty feet in elevation below the present road".[26] The other bridge site was "just above the Falls," but the landscape architect pronounced it unsatisfactory as "the road would encroach too closely upon the Falls and that immediate vicinity".[27]

After a visit to Lava Creek in 1932, Park Landscape Architect Kenneth McCarter and the Bureau of Public Roads engineers agreed to a location which crossed "the marsh at the vicinity of the 'beaver dams', followed the present road and crossed Lava Creek at or just below the present bridge."[28] By September of 1932, the Bureau had the plans completed for the Lava Creek Bridge and the contractor, S.J. Groves and Sons, began construction in November 1832.

DESCRIPTION

The single-span reinforced concrete slab bridge has a maximum span length of 32', measured from center of support to center of support. The structure length is 76' from end of wing wall to end of wing wall. The deck width is 30' and the bridge roadway from curb to curb is 24' wide.[29]

The slab is reinforced with nine longitudinal steel I-beams encased in concrete with their bottom flanges exposed. The outer two I-beams are 14-inch, 95-pound CB, and 20-inch, 55-pound CB sections while the inner I-beams are 14-inch, 87-pound CB sections. These I-beams have transverse bracing near their ends in the form of 10-inch, 20-pound channels connected to the I-beams by 4"x4"x⅜" angles. Just to the inside of where these channels attach to the I-beams are bearing plates. These bearing plates consist of a sole plate riveted to the I-beam, a middle plate, and a masonry plate sunk into the masonry. For the 14-inch beams these plates are 10"x¾"x14", 4"x¾"x14", and 8"x¾"x15" respectively. For the 20-inch beam these plates are 10"x¾"x8", 4"x¾"x8", and 8"x¾"x9" respectively. Besides the I-beam reinforcement the slab also has reinforcing bars. There are ½-inch diameter longitudinal bars placed by the I-beams and midway between the I-beams near the top and bottom of the slab. Transverse reinforcement consists of ½-inch diameter bars 1'-0" on center near the top and bottom of the slab. The bottom transverse bars are in segments between the I-beams reinforcement.[30]

The guard rail consists of 4-inch tubing posts, 6'-0" on center, sunk into a 6"x5" well 1'-7", or 1'-10" deep, on the side without a sidewalk. This tubing and well were filled with concrete after the posts were set and aligned. The posts have cast-iron caps. Three-inch, 6-pound channels are attached to the posts with angles near the top and bottom to form rails. One-inch diameter bars, 8¾" on center, frame into the rails vertically.[31]

The abutments batter 2:12 on the outside and are vertical on the inside except at the base where they batter 6:12. The wing walls batter 1:12 on the outside and are vertical on the inside except at the base where they batter 6:12. The east abutment is 10'-5½" from its base to the deck while the west abutment is 10'-¾" from its base to the deck. The parapets of the wing walls rise 2'-4" above the deck. The abutments have a concrete seat to receive the deck. The abutments rest on spread footings on firm material. The wing walls are slightly flared and are 22' long.[32]

This bridge was completed in 1933. The estimate of material quantities were as follows:

Structural steel	27,000 pounds
Reinforcing steel	4,500 pounds
Class "D" concrete	70 cu. yds.
Steel handrail	625 lin. ft.
Masonry	275 cu. yds.
Excavation	450 cu. yds.[33]

In the 1985 Parkwide Engineering Study, the bridge was listed in fair condition. The rails and parapets do not meet the current safety standards.

ENDNOTES

1.K. Huppe, "Literature Search Emigrant-Gardiner 69 KV", Highland Technical Services, The Montana Power Company, March 1988, p.111.

2.J.T. Pardee, A brief overview of the New World Mining District, 1918, Yellowstone National Park archives.

3.Philetus W. Norris, Report Upon the Yellowstone National Park to the Secretary of the Interior for the Year 1877 (Washington D.C.: Government Printing Office, 1877) pp.843-44.

4.Norris, Report Upon the Yellowstone ... 1878, p.984.

5.Norris,Report Upon the Yellowstone ... 1879, pp.6-7.

6.Norris, Annual Report of the Superintendent of the Yellowstone National Park for the Year 1880 (Washington D.C.: Government Printing Office, 1881) pp.10 and 38.

7.Norris, Fifth Annual Report of the Superintendent (Washington D.C.: Government Printing Office, 1881) pp.9 and 69-70.

8.Captain Moses Harris, U. S. Army, *Annual Report of the Superintendent of the Yellowstone National Park, 1887.* (Washington D. C.: GPO, 1887), p. 9.

9.Captain George Anderson to Secretary of War, Monthly Report, July 3, 1897.

10."Report from Colonel S. M. Young, Acting Superintendent, Yellowstone National Park to Quartermaster General, U. S. Army, August 13, 1897."

11.Captain Hiram Chittenden, *Improvement of Yellowstone National Park, Including the Construction, Repair and Maintenance of Roads and Bridges. (Annual Report of the Chief of Engineers for 1902, Being Appendixes FFF and III.), (Washington D. C.: GPO, 1902), pp. 3045-46.*

12.Hiram Chittenden, *Annual Report Upon the Construction, Repairs, and Maintenance of Roads and Bridges In The Yellowstone National Park and Construction of Military Road from Fort Washakie To Mouth of Buffalo Fork of Snake River, Wyoming. Being Appendixes GGG and KKK of the Annual Report of the Chief of Engineers for 1903.* (Washington D. C.: GPO, 1903), p. 2893.

13.Captain Hiram Chittenden, Annual Report Upon the Construction, Repair and Maintenance of Roads and Bridges In The Yellowstone National Park, Being Appendixes FFF and KKK of the Annual Report of the Chief of Engineers for 1904. (Washington D. C.: GPO, 1904), p. 4173. According to Lee Whittlesey's Yellowstone Place Names, Oxbow Creek flows north to the Yellowstone River from above Phantom Lake. In 1878, Ferdinand Hayden named the creek, "Geode Creek", but the name was officially switched to Oxbow Creek between 1915 and 1921.

14.Chittenden, *Improvement of Yellowstone National Park, Including the Construction, Repairs and Maintenance of Roads and Bridges. (Annual Report of the Chief of Engineers for 1904,* Being Appendixes FFF and KKK.).

15.Captain Hiram Chittenden, *Improvement of Yellowstone National Park, Including the Construction, Repairs and Maintenance of Roads and Bridges. (Annual Report of the Chief of Engineers for 1905, Appendix FFF.) Washington D. C.: GPO, 1905), pp. 2818-2819.*
Major Hiram Chittenden, First Lieut. Ernest Peek, Major John Mills, and First Lieut. Francis Pope. Annual Reports Upon the Construction, Repairs, and Maintenance of Roads and Bridges In The Yellowstone National Park and the Roads Into Mount Rainier National Park Being Appendixes GGG and JJJ of the Annual Report of the Chief of Engineers for 1906. *(Washington D. C.: GPO, 1906), p. 2257.*

16.First Lieut. Ernest Peek and Major Hiram Chittenden, *Report Upon The Construction, Repairs, and Maintenance of Roads and Bridges In The Yellowstone National Park and Report Upon the Road Into Mount Rainier National Park.* (Washington D. C.: GPO, 1907.), p. 2465.

17.Captain C. H. Knight. Improvement of Yellowstone National Park, Including the Construction, Repair and Maintenance of Roads and Bridges. (Annual Report of the Chief of Engineers, 1913, Appendix EEE.).

18.A discussion of the entire Gardiner, Montana to Cooke City, Montana road can be found in the History of the Northeast Entrance Road (HAER NO. WY-12, Lamar River Bridge). This history describes the interaction between the National Park Service and private industry over the construction and maintenance of this road. Part of the discussion involves the Mammoth Hot Springs to Tower Falls segment.

19.Arno B. Cammerer to Thomas McDonald, 11 September 1926, Box Roads, General Correspondence 1919-1926, File, Roads Correspondence May-December 1926, Yellowstone National Park Archives, Yellowstone National Park.

20."Annual Report of the Superintendent of Yellowstone National Park for 1933".

21.The existing road to Tower Falls from Mammoth Hot Springs is unsatisfactory as to both gradient and alignment. Its point of departure from the Mammoth area, however, is from a satisfactory and logical point which is retained in the proposed plan. I carefully inspected the routes proposed by the Bureau of Public Roads engineers as well as the existing road. I do not approve of the location recommended by them on the north side of Gardner River and Lava Creek for the following reasons:

1. a new wide scar would be created on the slopes of Mt. Evarts which would take many years to heal
2. because there is no timber growth on the south slope of Mt. Evarts the entire road would always be in full view from many points
3. a switchback is necessary and would require exceedingly heavy construction on the steep slopes
4. the fine views of Mt. Evarts and those down the Gardner River Valley now obtained on the existing road, would be lost on the proposed location.

After studying the problem and discussing it with Chief Landscape Architect Vint, I recommend that the new road to Tower Junction be constructed along the south side of Lava Creek utilizing as much of the existing alignment as may be practicable. At a point about 1/4 mile down stream on the Gardner River from the present steel bridge, a new high level bridge could be erected, if necessary constructed on a grade. This structure would be entirely satisfactory if built of steel, preferably with open, fully centered arches, and then painted gray to harmonize with the color of the existing rock outcrops. If a switchback was found to be necessary between the bridge over the Gardner River and Undine Falls, there is a wide stretch of land between Lava Creek and the existing road, which would lend itself well for such a purpose. The south bank of Lava Creek is well wooded and the road from the bridge to Undine Falls would be hidden from view and at the same time views from it are obtained of Mt. Evarts, the distant mountains down the Gardner River Valley, and the Hot Springs formations at Mammoth Hot Springs. Mr. Vint advised me, upon his arrival at Mammoth Hot Springs that he had previously worked out such a scheme as I have recommended and he concurred in my views. (Report by Clark Gilmore, Landscape Architect, Westchester County Park Development, New York, to Horace Albright, Director of the National Park Service, June, 1930. C.F. Capes, "Final Survey Report (1937) 1-H3 Bridge Investigation and Design Grand Loop Highway Yellowstone National Park, Wyoming.")

22.C. S. Cape, "Progress Report, Season of 1939 on Public Administration Activities on the Yellowstone National Park Highway System, Yellowstone National Park, Wyoming. Federal Works Agency Public Roads Administration District No. 3. December 18, 1939". Technical Information Center, Denver Service Center, National Park Service, Denver, Colorado.

23."Parkwide Road Engineering Study of the Yellowstone National Park System, Draft Report, October, 1986", U. S. Department of Transportation, Federal Highway Administration, Vancouver, Washington, 1986, Volume I.

24.Daniel Hull to Burt Burrel, 15 February 1926.

25.*Ibid.* In a July 24, 1990, telephone call to Yosemite National Park, Mary Shivers Culpin found that the Slate Gulch Bridge over the Merced River is not extant. In fact, Slate Gulch is outside of the boundary of Yosemite National Park.

26."Monthly Narrative Report, October 31, 1930, Yellowstone National Park, District No. 3".

27.*Ibid.*

28."Report of the Landscape Architect, Kenneth McCarter, Yellowstone National Park, for July 18-23, 1932."

29."Bridge Safety Inspection Report, Lava Creek Bridge over Lava Creek. U. S. Department of Transportation, Federal Highway Administration, Western Direct Federal Division, July 7, 1985."

30."Lava Creek Bridge Plans, U. S. Department of Agriculture, September, 1932."

31.*Ibid.*

32.*Ibid.*

33.*Ibid.*